Moving platform gravity import and levelling (C09)

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This chapter contains a worked example showing how to level gravity data acquired on a moving platform. In this example the moving platform is a ship at sea.

Most marine gravity data is acquired during a seismic work program. The layout of the survey lines is optimised for the seismic data rather than for the gravity data. As a result, marine gravity data may not be acquired on a regular grid pattern.

In addition, the user may want to level different vintages of marine gravity data to create a self consistent levelled dataset. The problem is then to level a dataset which has survey lines of varying lengths and varying bearing angles. The density of data observations may also vary significantly from one place to another. This makes it difficult, if not impossible, to use standard levelling methods which have been designed for regularly flown airborne data

The INTREPID moving platform marine gravity levelling was designed to apply systematic network adjustments ('levelling') to these datasets.

INTREPID uses line levelling methods for this process. The Split Cruise tool divides each cruise or sortie into 'reasonably straight' line segments. The Marine Level tool then applies a network adjustment to the survey data. There are various options for doing this. The adjustment can be done either with or without reference to an external dataset, eg: satellite altimeter data.

The marine gravity data used in this example has a nominal precision of approximately ± 2 mGal.

Location of sample data for Cookbooks

Where ***install_path*** is the path of your INTREPID installation, the project directory for the *Cookbooks* sample data is ***install_path*****\sample_data\cookbooks**.

For example, if INTREPID is installed in
C:\Program Files\Intrepid\Intrepid4.5,
then you can find the sample data at
C:\Program Files\Intrepid\Intrepid4.5\sample_data\cookbooks

For information about installing or reinstalling the sample data, see "Sample data for the INTREPID Cookbooks" in Using INTREPID Cookbooks (R19).

For a description of INTREPID datasets, see Introduction to the INTREPID database (G20). For more detail, see INTREPID database, file and data structures (R05).

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Moving platform import and levelling worked example 1

Overview

1. Import the raw data into INTREPID line datasets using the Import tool.
2. Split the cruises into reasonably straight line segments using the Split Cruise tool.
3. Use the Observed gravity to calculate the FreeAir anomaly. Convert units from µm/s2 to milliGals.
4. Merge the separate line datasets using the Project Manager's Append operation.
5. Use the Marine Level tool to compute and apply a network adjustment using the method of loop closure levelling. This method adjusts the data to be internally consistent, and does not require an external reference dataset such as a satellite altimeter model.
6. Grid and examine the results.

Preliminary notes

The example data can be found in
***install_path*\sample_data\cookbooks\levelling\marine.**

The raw data for each cruise is contained in an ASCII file. The files contain water depth, gravity and magnetic data. We are only processing the gravity data.

The file names are, for example:

```
0004.asc    0053.asc    0055.asc    0056an.asc    0096.asc
0097.asc    0101an.asc  0110an.asc  0127an.asc    0128.asc
0136an.asc  0161.asc    0167an.asc  0168a.asc     0174an.asc
1339.asc    1359fd.asc
```

Each of the ASCII files has the following format (the first line shown here is to identify the field names for these steps and is not part of the file.)

```
Survey Time  Latitude Longitude    depth gravity mag    residual_mag
 3.016.0740 -11.82834 131.55832   -21    9782666 46040  20
 3.016.0750 -11.80500 131.56165   -24    9782670 46032  28
 3.016.0800 -11.78334 131.56333   -29    9782670 46024  34
```

INTREPID has powerful batch processing tools, which make it simple to process multiple files in a single run. The following steps include examples of task specification files, which can process all of the data together. Naturally, before using this feature, you would conduct tests using the INTREPID tools interactively. Note, however, that the Split Cruise and Marine Level tools are only available in batch mode in the current version of INTREPID.

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Steps to follow

1 Import the ASCII files into INTREPID line datasets and assign them the following names:

```
raw0004   raw0053   raw0055   raw0056an   raw0096
raw0097   raw0101an raw0110an raw0127an   raw0128
raw0136an raw0161   raw0167an raw0168a    raw0174an
raw1339   raw1359fd
```

Use ASCII Columns input format with the following data definition file (DDF):

```
TYPE(LINE)
SurveyID  1-4   INTEGER*4
Time      6-13  REAL*8
Latitude  14-23 REAL*8    IsY PROJ(GEODETIC,WGS84)
Longitude 25-33 REAL*8    IsX PROJ(GEODETIC,WGS84)
Depth     34-39 REAL*4
Gravity   40-47 REAL*8
Magnetic  48-53 REAL*8
Residual  54-59 REAL*8
GROUP BY  SurveyID
```

In our example, this DDF is called **marine.ddf**. Further examples of INTREPID DDFs can be found in the ***install_path*/examples/DDF** directory.

The task specification (**.job**) file **import.job** will perform the operation for all **nnnn.asc** files in a single batch task. Since this task contains a **Repeat** loop, you must submit it to the Project Manager rather than directly to the Import tool.

To run the task, assuming that the task specification file is called **import.job**, use the command:

```
fmanager.exe –batch import.job
```

INTREPID will perform the task once for each value in the **Inputs** list. Each time it performs the task it will substitute the current **Inputs** value for the parameter **$Inputs** in the task specification. In this way it will create each of the **raw***nnnn* datasets.

See "Special Project Manager batch task operations" in INTREPID task specification (.job) files (R06) for full instructions on the techniques used in this task specification file.

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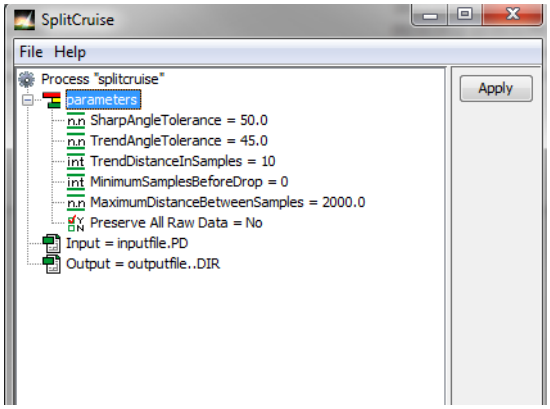
For each **Inputs** value the Import tool imports the **nnnn.asc** file into the corresponding **raw***nnnn* dataset.

```
Repeat Begin

Inputs = {
0004
0053
0055
0056an
.
.
etc
}

Process Begin
      Name = import
      Input = ./Rawdata/$(Inputs).asc
      Output = ./raw$(Inputs)
      Parameters Begin
            Format = AsciiColumns
            AsciiColumns Begin
                  FixedLength = No
                  SkipRecords = 0
                  DDF = "./marine.ddf"
                  NoError = No
                  ReportDiagnostics = No
            AsciiColumns End
      Parameters End
Process End

Repeat End
```

2 Split the cruises into 'reasonably straight' line segments using the INTREPID Split Cruise tool. The Split Cruise tool creates a new **SPLITLINE** field, which assigns a unique line number for each straight line segment. This line number is a combination of the **SurveyID** and the sequentially numbered line segment within the dataset divided by 10000. For example, a split dataset created from a dataset with **SurveyID** 5 would have line numbers 5.0001, 5.0002, 5.0003, …

Using the current version of INTREPID you can run the Split Cruise tool in batch mode or by selecting the Marine Split tool found under Levelling of the Project Manager.



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The task specification (**.job**) file **splitcruise.job** will perform the operation for all **raw***nnnn* datasets in a single batch task. Since this task file contains a **Repeat** loop, you must submit it to the Project Manager rather than directly to the Split Cruise tool.

To run the task, assuming that the task specification file is called **splitcruise.job**, use the command.

```
fmanager.exe –batch splitcruise.job
```

INTREPID will perform the task once for each value in the **Inputs** list. Each time it performs the task it will substitute the current **Inputs** value for the parameter **$Inputs** in the task specification. In this way it will create each of the **split***nnnn* datasets.

For each **Inputs** value the Split Cruise tool divides the in the **raw***nnnn* dataset into reasonably straight segments and creates the corresponding **split***nnnn* dataset. The **Inputs** list is the same as in step 1 above.

```
Repeat Begin
  Inputs = {
 ...
   }
Process Begin
      Name = splitcruise
      Input = ./raw$(Inputs)
      Output = ./split$(Inputs)
      Parameters Begin
            SharpAngleTolerance = 50
            TrendAngleTolerance = 45
            TrendDistanceInSamples = 10
            MinimumSamplesBeforeDrop = 10
      Parameters End
Process End
Repeat End
```

The SplitCruise process will produce the following INTREPID datasets:

```
split0004   split0053   split0055   split0056an   split0096
split0097   split0101an split0110an split0127an   split0128
split0136an split0161   split0167an split0168a    split0174an
split1339   split1359fd
```

3 Convert the **gravity** field in each **split***nnnn* dataset from μm/s2 gravity to mGal **free-air** anomaly values and store the results in a new field called **FreeAir**.

The task specification (**.job**) file **freeair.job** will perform the operation for all **split***nnnn* datasets in a single batch task. Since this task contains a **Repeat** loop, you must submit it to the Project Manager rather than directly to the Spreadsheet Editor tool.

To run the task, assuming that the task specification file is called **freeair.job**, use the command.

```
fmanager.exe –batch freeair.job
```


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INTREPID will perform the task once for each value in the **Inputs** list. Each time it performs the task it will substitute the current **Inputs** value for the parameter **$Inputs** in the task specification. In this way it will process each of the **split***nnnn* datasets.

For each **Inputs** value the Spreadsheet Editor opens the corresponding **split***nnnn* dataset and creates a new field called **FreeAir**. The **Inputs** list is the same as in step 1 above.

```
Repeat Begin
 Inputs = {
...
}
Process Begin
  Name = dbedit
  Parameters Begin
     Action Begin
         Type = OpenField
         Name = ./split$(Inputs)
     Action End
     Action Begin
         Type = CreateField
         Name = "FreeAir"
         Dtype = IEEE8ByteReal
         Width = 10
         GroupBy = No
         Initial = "FA(Latitude,Gravity/10)"
     Action End
   Parameters End
Process End

Repeat End
```

The function **FA()** is a user defined DLL/SO function. As used here it converts all of the values of the field **Gravity** to free air anomaly values, which it returns as the values of the function. (The arguments and the returned value of the function both represent arrays of values.) The calculation uses the respective value of the **Latitude** field in each case.

Note: The **gravity** value is divided by 10 before processing by **FA()**. This converts it from μm/s2 to mGal, required by the **FA()** function. In this example the FreeAir is then converted from mGals back to μm/s2 by using the Spreadsheet Editor.

See "User defined DLL/SO functions" in The INTREPID SDK and API (R18) for full instructions on creating and using these functions.

Note: The same process is available in batch mode using the INTREPID Gravity tool

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Here is a listing of the **FA()** function

```
/*
 * This program does the IGSN71 Free Air Anomaly calculation.
 *
 * This program uses dynamic library calls
 * from within the INTREPID Spreadsheet Editor tool.
 * You must compile this program and put it into a shared library
 *
 * Under UNIX it must have the name libFA.so.
 * and it must reside in the directory specified by the library
 * path ($LD_LIBRARY_PATH).
 * Under Windows it must have the name libFA.dll
 * and it must reside in a directory listed by the environment
 * variable PATH.
 *
 * We designed this module to be called from the INTREPID
.* Spreadsheet Editor tool(dbedit.exe) as FA(lat,obsgravity).
 * Where lat is in latitude degrees.
 *       obsgravity is in mgals .
 *
 * The prototype for a function xxx(f1,f2,...,fn) is
 * double* xxx(int npts,double* f1,double* f2,...,double* fn)
 */
#include <stdio.h>
#include <math.h>
double* FA(int npts,double* lat,double* obsgravity) {
        double PI=3.14159265358979323846;
        double* FAvalue = lat;
        double flt64Null = -5.0E+75;  /* This represents a null value */
        int i;
        /* Perform the calculation */
        double a1=978031.85;
        double a2= 0.005278895;
        double a3= 0.000023462;
        double sl,calcgrav;
        for (i=0;i<npts;i++) {
                if (lat[i]!=flt64Null && obsgravity[i]!=flt64Null) {
                        sl = sin(lat[i]*PI/180.0);
                        calcgrav = (a1*(1.0+a2*sl*sl+a3*sl*sl*sl*sl));
                    /*printf("lat %d %lf %lf %lf lf\n",
i,lat[i],sl,calcgrav,obsgravity[i]);*/

                        FAvalue[i] = obsgravity[i]-calcgrav;
                }
                else FAvalue[i] = flt64Null;
        }
        return(FAvalue);
}
```


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4 Merge the separate line datasets using the Project Manager's Append operation.

Up until now we have processed the raw data as separate surveys, one dataset per survey. Whether we keep the survey data separate or merge all the surveys into a single dataset really depends upon the network adjustment (levelling) strategy we wish to use. In this example we are going to use loop closure levelling to perform an internal network adjustment of all of the crossover points for all of the surveys. Because the adjustment is completely internal, ie; we are using no external dataset as a reference, all of the survey data must reside in a single dataset, in order for the Marine Level tool to find all of the crossover points.

The task specification (**.job**) file **append_datasets.job** will perform the operation for all **split***nnnn* datasets in a single batch task. Since this task contains a **Repeat** loop, you must submit it to the Project Manager.

To run the task, assuming that the task specification file is called **append_datasets.job**, use the command.

```
fmanager.exe –batch append_datasets.job
```

INTREPID will perform an append task once for each value in the **dataset** list. A new dataset, called **master..DIR**, will be created from appending all of the **split***nnnn* datasets together.

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5 Use the Marine Level tool to perform an internal network adjusment using all of the crossovers as control points. Marine Level will calculate the crossover points then minimise the misclosure errors throughout the crossover network, using the method of loop closure levelling.

Using the current version of INTREPID you must run the Marine Level tool in batch mode.

The task specification (**.job**) **levelloop.job** will perform the network adjustment on the **master..DIR** dataset.

To run the task, assuming that the task specification file is called **levelloop.job**, use the command.

```
fmanager.exe –batch levelloop.job
```

The Marine Level tool will process the input **FreeAir** field. It stores the levelled data in a new field called **FreeAir_loop**.

```
Process Begin
      Name  = marinelevel
      Comments= "Intrepid Audit Stamp ..."
      ReportFile= marine_level.rpt
# Primary input dataset
        Dataset = ./master..DIR
        InputZ = ./master..DIR/FreeAir
        OutputZ = ./master..DIR/FreeAir_loop
# Xovers
      OutputXover = ./crossovers..DIR
      Parameters Begin
            Method Begin
                  RunType= LevelLoop
                  ByCruise= No
            Method End
            PopulationAnalysis= Yes
            SaveEmptyGroupsInXover= Yes
            DoPseudoFidsAsRecords= Yes
            DuplicateCrossOver_Fid_Tolerance= 0.001
            MaximumPointSeparation= 10000.0
            MaximumInterpolationGap= 10000.0
            WeightMethod= Unity
      Parameters End
Process End
```


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Parameters

RunType: If the crossover adjustment is done without reference to an external dataset, then the valid options are **LevelLoop** and **LevelPolynomial**. See "Loop closure levelling" in Chapter 1 "Levelling line datasets" in Reference Manual volume 3 for further information about the loop levelling process.

ByCruise: Set this to **Yes** if you wish to perform levelling by cruise. The splitcruise process will generate some 'lines' for which no crossovers are found. This option determines whether these lines get levelled or not. In levelling by cruise, the levelling process is applied to the whole of a cruise, and completely ignores the break-down into the 'lines' that were created by the split-cruise process.

PopulationAnalysis: Set this to **Yes** if you wish to generate statistical reports for the input dataset(s), based upon histograms of crossover populations.

SaveEmptyGroupsInXover: Running Split Cruise often results in line segments which have no crossovers. Normally, crossover datasets do not include line segments with no crossovers. Set this to **Yes** if you wish to include them.

DoPseudoFidsAsRecords: The Marine Level tool requires a fiducial field to calculate the levelling adjustment. Usually this would be Time. If your data has no fiducial field, set this option to **Yes**, in which case the process will create a pseudo fiducial. (If this is not selected and there is no fiducial, the process will use the cumulative distance as a fiducial.)

DuplicateCrossOver_Fid_Tolerance: A rejection criteria for crossover points. If crossover points occur very close together they can cause levelling problems. This parameter sets a minimum tolerance on the allowable distance between crossovers. Where two crossovers are within this separation, one is rejected. The value has the same units as the X and Y fields (in this example 0.001 degrees (approx. 1 km)).

MaximumPointSeparation: A rejection criteria for crossover points. Where the survey points exceed this separation, the crossover is deemed less reliable, and is rejected. The value has the same units as the X and Y fields (in this example 10000 degrees, so effectively no limit).

MaximumInterpolationGap: This parameter controls the use of spline versus linear interpolation. For example, a value of zero forces linear interpolation everywhere. The value has the same units as the Fiducial field.

WeightMethod: In polynomial levelling, one part of the process requires fitting a polynomial to the misclosure data. A weighting scheme can be specified which determines the relative importance (or weight) of crossovers in the fitting process.

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Saving and loading crossovers

You can save a set of crossovers as a point dataset, and load it again during subsequent sessions. If you load a set of crossovers, INTREPID will use them instead of calculating a new set. For a large dataset this can represent a considerable saving of time. A crossover dataset also records the corrections which were calculated when it was created. If you set all levelling correction methods to **No** INTREPID will apply the levelling correction recorded in the crossovers dataset.

To save a crossovers dataset, use the statement **OutputXOver =** before the **Parameters Begin** statement to specify the crossover dataset to be created.

To load a crossovers dataset, use the statement **InputXOver =** before the **Parameters Begin** statement to specify the crossover dataset to be used.

Gridding

6 Grid the data and review the grid. The task specification (**.job**) file **grid_var.job** will perform the operation using an algorithm suitable for variable density data. Examine the grid using a sun angle view to locate levelling errors. You may wish to grid the unlevelled data and compare the two grids side by side. If you find errors, you may need to examine the raw data more closely. Further processing options would be to

- Examine the raw data for errors;
- Adjust the levelling parameters;
- Remove the line or lines causing the levelling error;
- Use the INTREPID Flight Path Editor to clip sections of lines at ship turning points. The acceleration caused by turning may cause gravity errors.

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Moving platform import and levelling worked example 2

Overview

1. Import the raw data into INTREPID line datasets using the Import tool.
2. Split cruises into reasonably straight line segments using the Split Cruise tool.
3. Convert the **`gravity`** field from μm/s2 gravity to mGal **`free-air`** anomaly values.
4. Prepare a satellite altimeter-derived gravity image for use as a levelling reference surface. **In the following example this preparation has been done for you.**
5. Use the Marine Level tool to compute and apply a network adjustment using the method of least squares piecewise polynomial fit.. This method adjusts the data to fit onto the lower resolution satellite altimeter regional gravity dataset. This dataset is also referred to as an external reference dataset.
6. Grid and examine the results.

Steps to follow

1. Import the ASCII files into INTREPID line datasets. Follow Step 1 of the previous example.
2. Split the cruises into 'reasonably straight' line segments using the INTREPID Split Cruise tool. Follow Step 2 of the previous example.
3. Convert the **`gravity`** field in each **`split`***`nnnn`* dataset from μm/s2 gravity to mGal **`free-air`** anomaly values and store the results in a new field called **`FreeAir`**. Follow Step 3 of the previous example.

Prepare levelling reference surface

4. Prepare a satellite altimeter-derived gravity image for use as a levelling reference surface. Essentially this involves converting an image into an INTREPID line dataset with crossover control points. There are several steps required in doing this, and for the purpose of this exercise we have done the preparation for you. In this example we have used the Global Gravity Grid (v7.2) by Sandwell and Smith. These data are also referred to as the Geosat data, since much of the data was derived from that satellite. It has a resolution of 2 minutes (approx. 3700 metres or 0.033 degrees). The grid was downloaded from the TOPEX FTP site (FTP site : ftp://topex.ucsd.edu/pub/global_grav_2min/). The full image occupies approximately 70 Mbytes.

   We found it beneficial to remove some high frequency noise (less than 30 km wavelength) from the image. To do this, import it to an INTREPID grid dataset using the Binary Image import format. Use the INTREPID Subsection tool to extract the geographic region you require. Use the INTREPID Spectral Domain Grid Filters to apply a low pass filter. Export the resulting grid to a file in ASCII Image XYZ format.

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The exported data should be similar to the following. (The first line shown here is to identify the field names for these steps and is not part of the file.)

```
(Longitude Latitude    FreeAir)
 118.017   -6.99924    51.8000
 118.083   -6.99924    49.4000
 118.350   -6.99924    71.4000
 118.383   -6.99924    75.4000
 118.450   -6.99924    86.2000
 118.483   -6.99924    90.4000
 118.550   -6.99924    97.2000
 118.583   -6.99924    99.0000
 118.617   -6.99924    98.8000
 118.750   -6.99924    113.000
```

Sort this file in order of **Longitude** and save it as **geosatA**. Sort the file in order of **Latitude** and save it as **geosatB**.

Append **geosatB** to **geosatA**.

Import **geosatA** into an INTREPID line dataset called **geosat..DIR**. Use ASCII Columns input format. The following data definition file (DDF) is suitable for the example above.

```
TYPE(LINE)
Longitude 5-11  REAL*8 IsX PROJ(GEODETIC,WGS84)
Latitude  14-22 REAL*8 IsY PROJ(GEODETIC,WGS84)
FreeAir         REAL*4
```

Split the **geosat..DIR** dataset into 'reasonably straight' line segments using the INTREPID Split Cruise tool. Call the resulting dataset **split_geosat..DIR**. This dataset will contain a set of North-South lines covering the survey area and a set of East-West lines also covering the survey area. Importantly, this dataset contains crossover control points which are used by the INTREPID MarineLevel tool. This **split_geosat..DIR** dataset is provided for you.

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Marine Level

5 Use the Marine Level tool to fit the individual surveys (**splitnnnn**) onto the lower resolution satellite based regional gravity using a least squares piecewise polynomial fit. Marine Level compares crossovers of the cruise data with the satellite data in the levelling process.

Up until now we have processed the raw data as separate surveys, one dataset per survey. Whether we keep the survey data separate or merge all the surveys into a single dataset really depends upon the network adjustment (levelling) strategy we wish to use. In this example we are going to use polynomial levelling to perform a network adjustment of the crossover points for all of the surveys, using the geosat dataset as the reference surface. Because we are using an external dataset as a reference, there is no need for all of our survey data to reside in a single dataset. We can process the **split***nnnn* datasets individually, without having to append them together.

Using the current version of INTREPID you must run the Marine Level tool in batch mode.

The task specification (**.job**) file **levelpoly.job** will perform the Marine Level task for all **split***nnnn* datasets in a single batch task. Since this task contains a **Repeat** loop, you must submit it to the Project Manager rather than directly to the Marine Level tool.

To run the task, assuming that the task specification file is called **levelpoly.job**, use the command.

```
fmanager.exe –batch levelpoly.job
```

INTREPID will perform the task once for each value in the **Inputs** list. Each time it performs the task it will substitute the current **Inputs** value for the parameter **$Inputs** in the task specification. In this way it will process each of the **split***nnnn* datasets.

For each **Inputs** value the Marine Level tool opens the corresponding **split***nnnn* dataset levels the **FreeAir** field. It stores the levelled data in a new field called **FreeAir_poly**. The **Inputs** list is the same as in step 1 above.

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```
Repeat Begin
 Inputs = {
...
}
Process Begin
      Name  = marinelevel
      Comments= "Intrepid Audit Stamp ...
      ReportFile= marine_level.rpt
# Primary input dataset
        Dataset = ./split$(Inputs)
        InputZ = ./split$(Inputs)/FreeAir
        OutputZ = ./split$(Inputs)/FreeAir_poly
# Reference dataset
      OtherDataset = ./split_geosat
      OtherInputZ = ./split_geosat/FreeAir
# Xovers
      #OutputXover = ./crossovers..DIR
      Parameters Begin
            Method Begin
                  RunType= LevelPolynomial
                  ByCruise= No
            Method End
            PopulationAnalysis= Yes
            SaveEmptyGroupsInXover= Yes
            DoPseudoFidsAsRecords= Yes
            DuplicateCrossOver_Fid_Tolerance= 0.001
            MaximumPointSeparation= 10000.0
            MaximumInterpolationGap= 10000.0
            Polynomial Begin
                  Width = 15
                  Order = 0
                  MinNpts= 2
                  ConvolveWidth= 5
                  DistanceWeighted= No
            Polynomial End
            WeightMethod= Unity
      Parameters End
Process End
Repeat End
```


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Parameters

RunType: If the crossover adjustment is done with reference to an external dataset, then the valid options are **LevelPolynomial, LevelDC, LevelLinesDC** and **LevelDrape**. If you choose the **LevelPolynomial** option you must include the following four Polynomial parameters.

Polynomial Width: Use this to specify the number of crossover points to use in the piecewise polynomial used for levelling.

Polynomial Order: Use this to specify the order of the polynomial fit.

Polynomial Minimum Points: Use this to specify the minimum number of crossover points in a line for the levelling adjustment to be applied. INTREPID will not attempt to adjust lines with fewer crossover points than you specify here.

Polynomial Convolve Width: After INTREPID calculates the levelling corrections it applies a smoothing convolution filter to the data. This filter removes high frequency components of the data. Use this parameter to specify the width (in data points) of the convolution kernel.

LevelDC: Use this option if you wish to make a 'DC' adjustment (add or subtract a constant value) to the **entire** dataset such that it best fits the external reference dataset.

LevelLinesDC: Use this option if you wish to make a 'DC' adjustment (add or subtract a constant value) to individual line segments within the dataset such that it best fits the external reference dataset.

LevelDrape: Use this option if you wish to adjust the input dataset to the reference dataset using piecewise linear interpolation, making all misclosures equal to zero.

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Gridding

6 Grid the data and review the grid. The task specification (**.job**) file **grid_multivar.job** will perform the operation using an algorithm suitable for variable density data. It will read the data from a list of separate datasets, avoiding the need to append all of the data together into a single dataset. Examine the grid using a sun angle view to locate levelling errors. You may wish to grid the unlevelled data and compare the two grids side by side. If you find errors, you may need to examine the raw data more closely. Further processing options would be to

- Examine the raw data for errors;
- Adjust the levelling parameters;
- Remove the line or lines causing the levelling error;
- Use the INTREPID Flight Path Editor to clip sections of lines at ship turning points. The acceleration caused by turning may cause gravity errors.

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